

## **Title: A Pen for Penny**

### **Brief Overview:**

This unit is a reinforcement of the concepts of area and perimeter of rectangles. Methods for maximizing area while perimeter remains the same are also included. The storyline gives a real-world problem while allowing students to use mathematics to perform the given task. Conclusively, the students will determine the best method for maximizing area, make a written conclusion regarding maximizing area, and be assessed.

### **Links to NCTM Standards:**

- **Mathematics as Problem Solving**  
Students will use problem-solving strategies to investigate the effect perimeter has on area. Students will apply formulas for the perimeter and area of a rectangle to real-world situations.
- **Mathematics as Communication**  
Students will communicate their ideas verbally within their groups while using manipulatives and performance tasks, as well as in written form throughout the unit.
- **Mathematics as Reasoning**  
Students will use reasoning skills to determine the best method for maximizing area.
- **Mathematical Connections**  
Students will make connections between geometry and basic algebraic equations while solving real-life situations.

### **Links to Maryland High School Mathematics Core Learning Goals:**

- **1.1.1**  
The student will recognize, describe, and extend patterns and functional relationships that are expressed numerically, algebraically, and geometrically.
- **2.2.2**  
The student will solve problems using two-dimensional figures.
- **2.3.2**  
The student will use techniques of measurement and will estimate, calculate, and compare perimeter and area of two- and three-dimensional figures and their parts. The results will be expressed with appropriate precision.

### **Grade/Level:**

This unit is appropriate for students in Grades 8-12 enrolled in Pre-Algebra, Algebra I, and Geometry.

### **Duration/Length:**

Three to four days (variable)

## **Prerequisite Knowledge:**

Students should have working knowledge of the following skills :

- Calculating the area and the perimeter of a rectangle
- Evaluating algebraic expressions
- Solving algebraic equations

## **Objectives:**

Students will be able to:

- determine the best shape that will maximize area and minimize perimeter.
- apply algebraic/geometric expressions to solve real-world problems.

## **Materials/Resources/Printed Materials:**

- Pencil
- TI-83 Graphing Calculator
- Straightedge
- Warm-up and activity sheet

## **Development/Procedures:**

During this unit, students will work with group members or partners to determine whether or not area can change and perimeter remain the same, while strengthening their understanding of area and perimeter. In conclusion they will determine the shape which will always maximize area.

- Day One: Students will complete the warm-up activity (Day 1 warm-up) to reinforce the idea of area being multiplication and perimeter being addition. A group manipulative activity (Activity 1) will also be completed.
- Day Two: Students will complete a warm-up (Day 2 warm-up) to recall yesterday's lesson. At this point the teacher will introduce and give instructions for problem #1.
- Day Three: Students will need to complete problem #2 and #3. (Teacher must give instruction for graphing calculator use for problem #'s 2 and 3.)  
Warm-ups and templates for manipulatives and activity sheets are provided.

## **Extension/Follow Up:**

Students can use the Internet to research the cost analysis of this project. (i.e., fencing, cement, labor, etc.)

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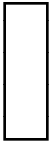
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**Day 1 Warm-up:** This warm-up is intended to review the concepts of perimeter and area of a rectangle.

**DIRECTIONS:** Calculate the perimeter and the area of each rectangle.

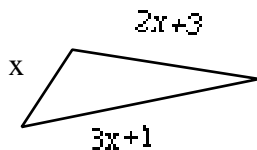
1.  Perimeter = \_\_\_\_\_  
Area = \_\_\_\_\_

2.  Perimeter = \_\_\_\_\_  
Area = \_\_\_\_\_

3.  Perimeter = \_\_\_\_\_  
Area = \_\_\_\_\_

4. A rectangle has an area of 2,130' and a width of 30'; find its length and perimeter.

5. The perimeter of the triangle below is 52 cm. Find the length of each side of the triangle. Show your calculations.



Name \_\_\_\_\_

**Activity 1:** Can two rectangles with identical perimeters have different areas?

**Remember:** Each paper square is 1 cm x 1 cm. You do not need to use all the paper squares.

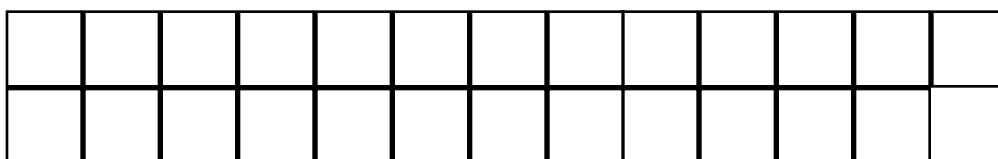
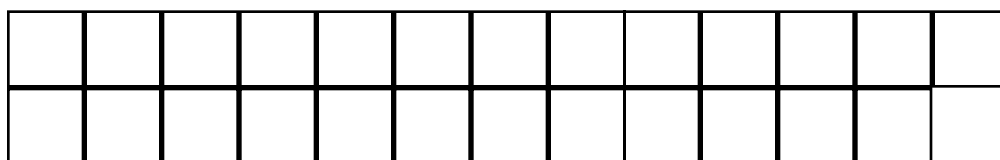
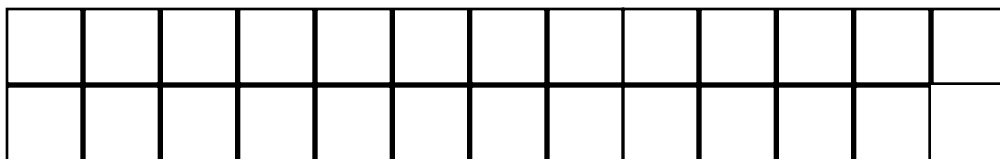
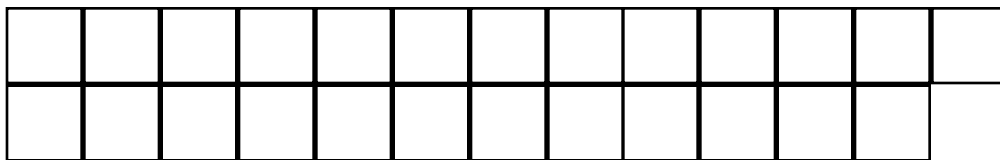
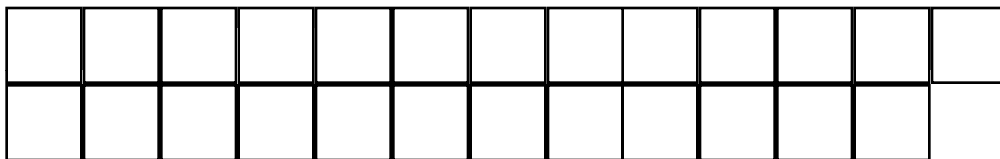
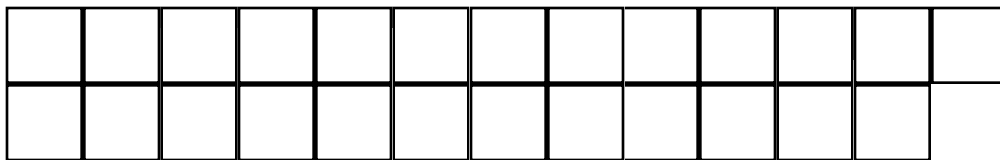
- 1)
  - a) Construct a rectangle which has a perimeter of 20 centimeters using the paper squares. After it is constructed, sketch your rectangle below and label the dimensions of the sides.
  - b) What is the area of the rectangle you constructed? Show your calculations below.
- 2)
  - a) Can you construct a second rectangle with the paper squares which still has a perimeter of 20 centimeters but whose area is different? If you are able to, sketch it below.
  - b) What is the area of this rectangle? Show your calculations below.
- 3)
  - a) If you were not restricted to using the paper squares, how many different rectangles with a perimeter of 20 centimeters do you think could be constructed?

b) Explain in paragraph form (2 to 3 sentences) how you came to your conclusion above.

c) Will all the rectangles have identical areas? \_\_\_\_\_

4) Provide a written conclusion in sentence form which answers the original question posed at the top of the first page.

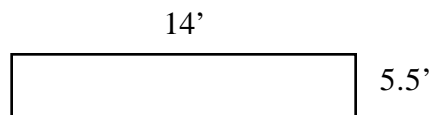
Activity 1 Materials: The blocks below are in sets of twenty five. Each student should receive one set, cut them out and use them to construct the rectangles discussed in the previous activity.



Name \_\_\_\_\_

**Day 2 Warm-up:** This warm-up is intended to review how to calculate area and perimeter and refresh students on yesterday's concepts.

1. Calculate the area and perimeter of the rectangle:



Perimeter = \_\_\_\_\_ Area = \_\_\_\_\_

2. A rectangle has an area of  $224 \text{ in.}^2$  and a width of 16 in.

a) Find the length of the rectangle.

b) What is the perimeter of the rectangle?

c) Sketch a rectangle below whose perimeter is the same as in (b) but whose area is different. Include dimensions in your sketch.

3. The length of a rectangle is 4 cm more than the width. The perimeter is 36 cm. Find the length and width of the rectangle. Show your calculations.

4. In paragraph form (3 or 4 sentences), explain what conclusions the class made yesterday about area and perimeter?

## ***ASSUMPTION FACT SHEET***

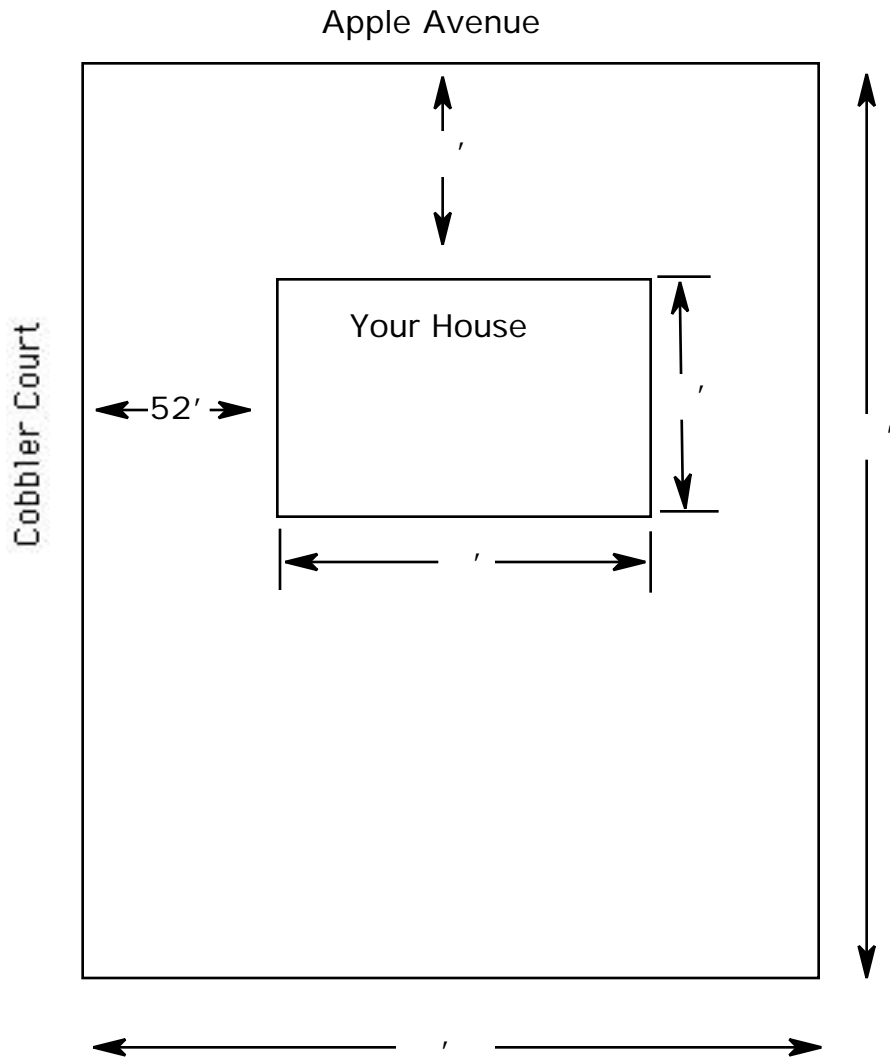
Your family has just purchased a new home. Your property is located in a high traffic area. You need to build a pet pen to protect “Penny,” who is very playful. Although Penny is a good dog she must be protected and placed in a pen. The pen needs to be designed to give her the largest area possible to roam freely.

Use the information below that you feel is needed to solve the problem:

- Your house is 28' x 42'.
- Penny loves to play frisbee.
- Penny's pen must be rectangular.
- Your house has 4 bedrooms and 3 bathrooms.
- You can only afford 40' of fencing.
- Your plot of land is 124' x 212'.
- Your house must be 40' from Apple Avenue which is parallel to the front of your house.
- Penny likes to eat steak.
- The fencing is 5' in height.
- Penny is eight years old.
- Your house is 52' away from Cobbler Court and there is 30' of yard on the other side of the house.
- Cobbler Court is perpendicular to Apple Avenue.
- Your house is located on a rectangular corner lot at the intersection of Cobbler Court and Apple Avenue.
- After living in the house for a few months, your family builds a 30' x 15' garage on your house (problem #3 only).



**Your Property (for problem #1)**



I. Given the dimensions of your property, your task is to build an isolated pen (away from the house) for Penny behind your house. You want to have the largest possible area for the pen to provide Penny room to roam freely. Write the data numbers in the spaces above and sketch or draw Penny's pen on your property. (Remember to label all measurements.)

NAME\_\_\_\_\_

**PROBLEM #1**

**I.** List the assumptions that are most relevant in determining the dimensions of Penny's pen.

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**II.** Fill in the table below and find a pattern to determine the most suitable dimensions for Penny's pen.

[A]	[B]	[C]	[D]	[E]	[F]
[Input]	$2 * [A]$	$40 - [B]$	$[C] / 2$	$[B] + [C]$	$[A] * [D]$
LENGTH	$2 * \text{LENGTH}$	$2 * \text{WIDTH}$	WIDTH	PERIMETER	AREA

**III.** Based on above findings, what is the maximum area that Penny's pen can be?

a)\_\_\_\_\_

b)Explain.\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

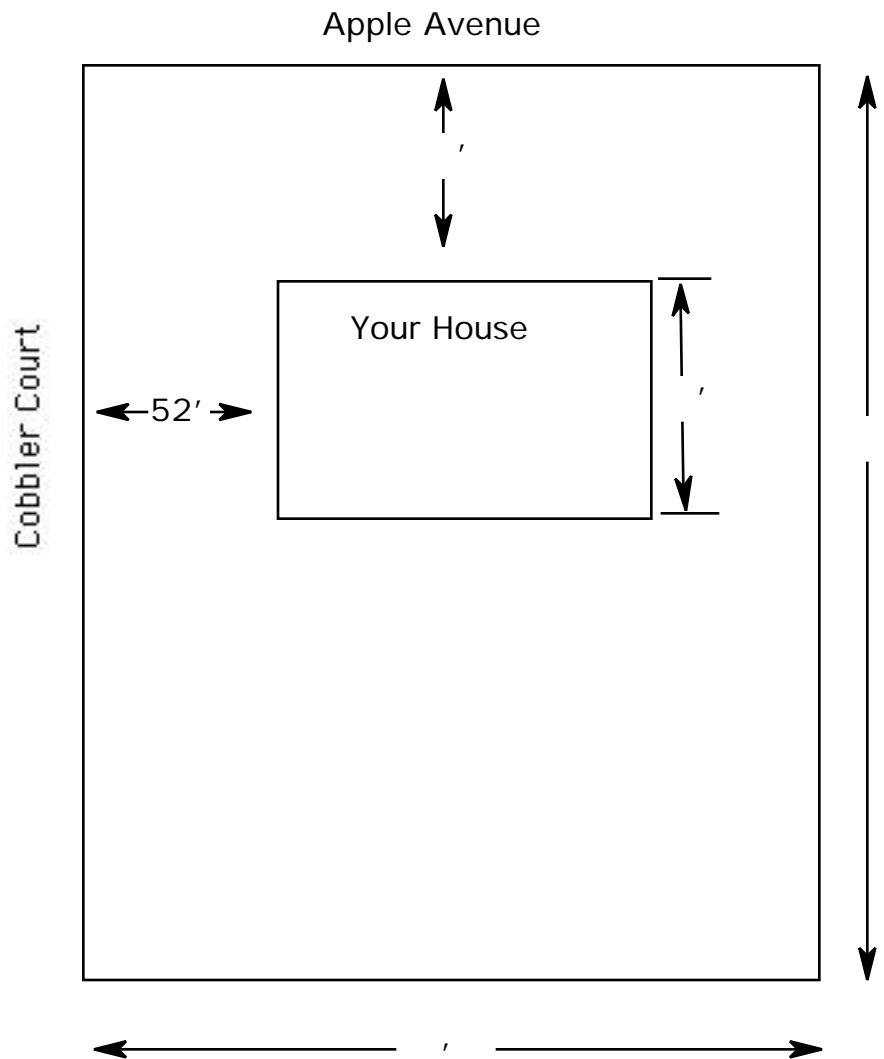
c)What geometric shape is Penny's pen? \_\_\_\_\_

\_\_\_\_\_

**IV.** Use your straightedge to draw Penny's pen on your property.

**V.** With your teacher, you will now construct the table you have created above on a graphing calculator. See Addendum 1 for detailed instructions.

**Your Property (for problem #2)**



II. Your next task is to design a pen for Penny which is not necessarily isolated (away from the house). You still want to maximize the area. (Remember to label all measurements and make a new sketch.)

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## PROBLEM #2

**I.** List the assumptions that are most relevant in determining the dimensions of Penny's pen (at least one should be different from those you listed in Problem #1).

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**II.** With your partner, design a table using a graphing calculator to solve the problem. Your table should make use of formulas to calculate data. When the table is complete, copy your column headings (the headings you would use if you were writing on paper), formulas, and the line of data which contains the maximum area in the table below.

Graph. Calc. Headings ->	L1	L2	L3	L4	L5	L6
Column Headings ->						
Formulas ->						
Maximum Area ->						

**III.** Based on the table you built, what is the new maximum area that Penny's pen can be?

a) \_\_\_\_\_

b) Explain. \_\_\_\_\_

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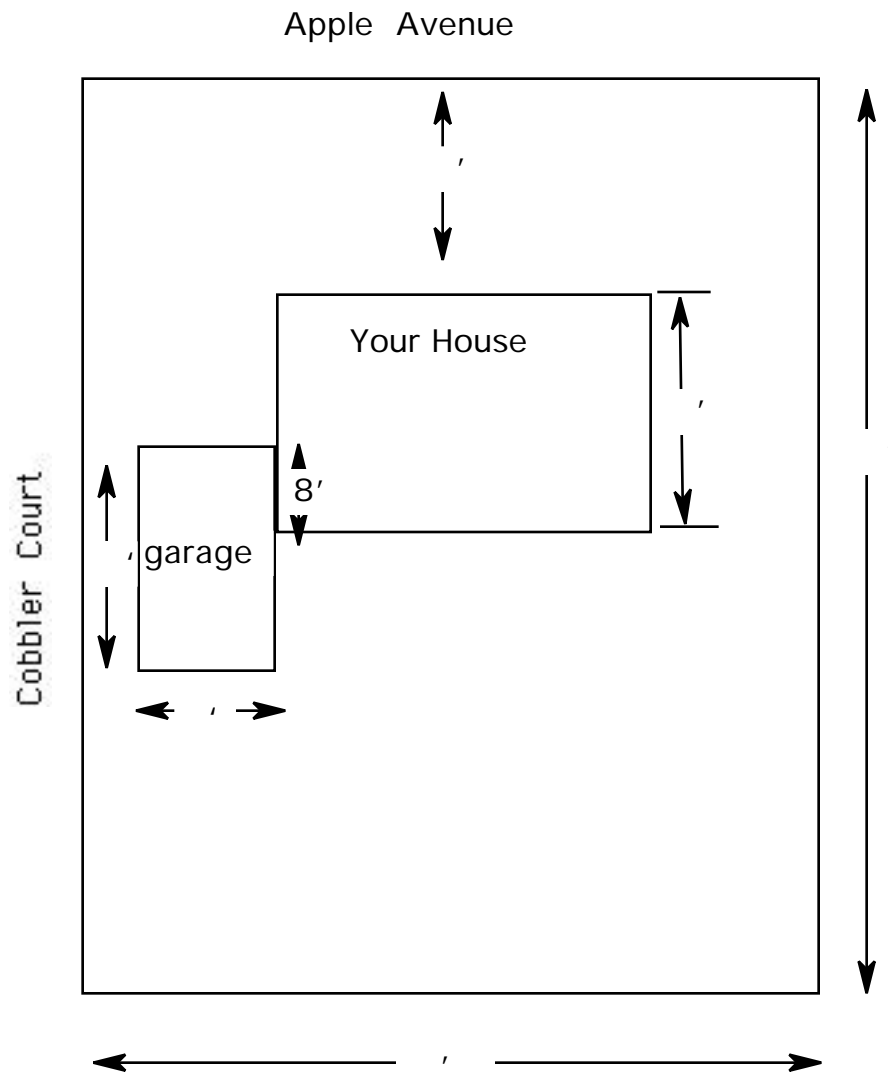
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c) What geometric shape is Penny's pen? \_\_\_\_\_

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**IV.** Use your straightedge to draw Penny's pen on your property.

**Your Property (with garage)(for problem #3)**



III. Your final task is to build a different pen for Penny. Remember you only have 40 feet of fencing to work with and you still want to have the largest possible area. (Remember to label all measurements.) (Hint: Your pen should not be isolated(away from the house).)

NAME\_\_\_\_\_

### PROBLEM #3

**I.** List the assumptions that are most relevant in determining the dimensions of Penny's pen (at least one should be different from those you listed in Problem #2).

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**II.** With your partner, design a table using a graphing calculator to solve the problem. Your table should make use of formulas to calculate data. When the table is complete, copy your column headings (the headings you would use if you were writing on paper), formulas, and the line of data which contains the maximum area in the table below.

Graph. Calc. Headings ->	L1	L2	L3	L4	L5	L6
Column Headings ->						
Formulas ->						
Maximum Area ->						

**III.** Based on the table you built, what is the new maximum area that Penny's pen can be?

a)\_\_\_\_\_

b) Explain.\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

c) What geometric shape is Penny's pen? \_\_\_\_\_

\_\_\_\_\_

**IV.** Use your straightedge to draw Penny's pen on your property.

**V.** a) What geometric shape were two of the three pens you designed for Penny?

\_\_\_\_\_

b) Can you draw a conclusion about maximizing area while keeping perimeter constant?  
Write your conclusion in complete sentences.

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### ***Addendum 1***

#### *Instructions for use of graphing calculator*

You will now use the graphing calculator to build the table you used in Problem #1. You will find that it does many of your tedious calculations for you.

**Note: Words in uppercase letters represent a button on your calculator.**

1) Press STAT, then 1. You should now see columns across your screen, labeled L1, L2, etc. Record the column headings from your table in order below:

L1:

L2:

L3:

L4:

L5:

L6:

2) If there is data in your columns you need to clear it out. Arrow up to the heading (L1) and press CLEAR. Then arrow down one or two spaces. The column should now appear empty. Do this to clear all your columns.

3) Enter the data in your first column under L1 (this should represent “length”) by using the number keys and the arrow keys.

4) Now that your numbers are entered you need to write the formulas which will calculate the rest of the data in your table. Arrow up and put your cursor over the heading L2.

5) The L2 column will calculate  $2 * \text{length}$  (remember that length is in column L1). You will enter the formula  $2 * L1$  by following these keystrokes:

2 ; X ; 2ND ; 1 (this will enter L1 in your calculator) ; ENTER

Column L2 should now have numbers in it. They should be double the numbers you entered in column L1.

5) Now arrow over to column L4 (we will go back to L3 next) and move your cursor over the heading L4. This column represents  $2 * \text{width}$ . A formula you could use to calculate this column is:  $40 - (2 * \text{length})$ . Remember,  $(2 * \text{length})$  is already calculated in L2 so our formula will be:  $40 - L2$ .

It should be entered into the calculator using the following keystrokes:

40 ; - ; 2nd ; 2 (this will enter L2); ENTER

6) Arrow back over to the L3 column heading. This column represents width. How do you think you will write the formula for this column? \_\_\_\_\_

7) A formula you could use is:  $(2 * \text{width}) / 2$  so this will be entered by following these keystrokes: 2nd ; 4 ; Divide ; 2 ; ENTER.

8) Arrow over to the L5 heading. This column calculates the perimeter of the fencing in feet. A formula you could use is  $(2 * \text{length}) + (2 * \text{width})$ .

remember this is:            L2            L4

To enter this formula, follow these keystrokes: 2nd ; 2 ; + ; 2nd ; 4 ; ENTER.

9) Arrow over to the L6 heading. This final column calculates area. A formula you could use is: length \* width. Which two columns were these? \_\_\_\_\_.

10) Enter this formula by following these keystrokes: 2nd ; 1 ; x ; 2nd ; 3 ; ENTER


11) Your table is now complete and should match the table you constructed using paper and pencil in Problem #1.

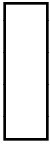


**Day 1 Warm-up:** This warm-up is intended to review the concepts of perimeter and area of a rectangle.

**DIRECTIONS:** Calculate the perimeter and the area of each rectangle.

1.  Perimeter = **58'**  
Area = **204 SQ. FT.**

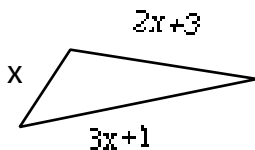
2.  Perimeter = **188'**  
Area = **2088 SQ. FT.**

3.  Perimeter = **48' + 2a**  
Area = **24a SQ. FT.**

4. A rectangle has an area of 2,130' and a width of 30'; find its length and perimeter.

**LENGTH = 71' AND PERIMETER = 202'**

5. The perimeter of the triangle below is 52 cm. Find the length of each side of the triangle. Show your calculations.



$$x + (2x+3) + (3x+1) = 52 \text{ cm}$$

$$6x + 4 = 52$$

$$6x = 48$$

$$x = 8 \text{ cm}$$

$$2x + 3 = 19 \text{ cm}$$

$$3x + 1 = 25 \text{ cm}$$

Triangle side lengths are: 8 cm, 19 cm,  
and 25 cm

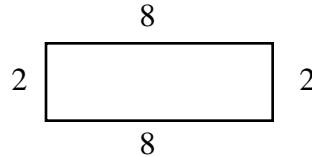
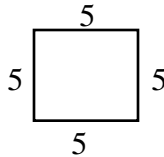
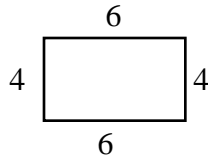
Name ANSWER KEY

**Student answers may vary and these are possibilities...**

**Activity 1:** Can two rectangles with identical perimeters have different areas?

**Remember:** Each paper square is 1cm x 1cm. You do not need to use all the paper squares.

- 1) a) Construct a rectangle which has a perimeter of 20 centimeters using the paper squares. After it is constructed, sketch your rectangle below and label the dimensions of the sides.



- b) What is the area of the rectangle you constructed? Show your calculations below.

$$6 \times 4 = 24 \text{ cm}^2$$

$$5 \times 5 = 25 \text{ cm}^2$$

$$2 \times 8 = 16 \text{ cm}^2$$

- 2) a) Can you construct a second rectangle with the paper squares which still has a perimeter of 20 centimeters but whose area is different? If you are able to, sketch it below.

**(Use one of the above rectangles)**

- b) What is the area of this rectangle? Show your calculations below.

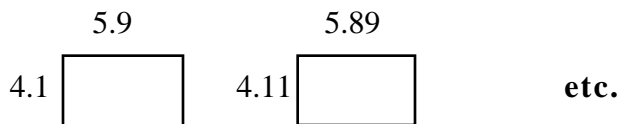
**(See one of the above)**

- 3) a) If you were not restricted to using the paper squares, how many different rectangles with a perimeter of 20 centimeters do you think could be constructed?

**An infinite number**

- b) Explain in paragraph form (2 to 3 sentences) how you came to your conclusion above.

**There were two rectangles that were formed earlier with blocks of length one. However, decimals could be used, as such:**



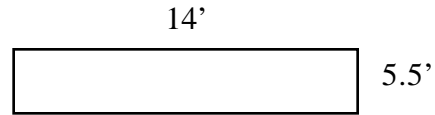
- c) Will all the rectangles have identical areas? **No**
- 4) Provide a written conclusion in sentence form which answers the original question posed at the top of the first page.

**Two rectangles with identical perimeters may have different areas.**

Name ANSWER KEY

**Day 2 Warm-up:** This warm-up is intended to review how to calculate area and perimeter and refresh students on yesterday's concepts.

1. Calculate the area and perimeter of the rectangle:



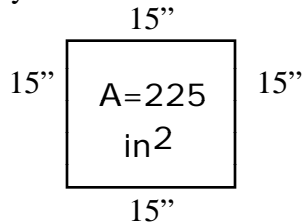
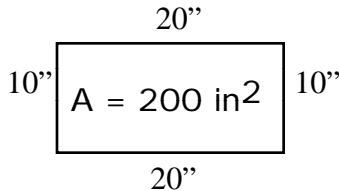
Perimeter = 39' Area = 77 ft<sup>2</sup>

2. A rectangle has an area of 224 in<sup>2</sup> and a width of 16 in.

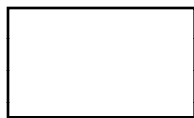
a) Find the length of the rectangle.  $224 / 16 = 14$  in.

b) What is the perimeter of the rectangle?  $(2 \times 14) + (2 \times 16) = 60$  in.

- c) Sketch a rectangle below whose perimeter is the same as in (b) but whose area is different. Include dimensions in your sketch. **Possible answers**



3. The length of a rectangle is 4 cm more than the width. The perimeter is 36 cm. Find the length and width of the rectangle. Show your calculations.



$x + 4$

$x = \text{width}$   
 $x + 4 = \text{length}$

$x + x + 4 = 36$  width = 16 cm

$2x + 4 = 36$  length = 20 cm

$2x = 32$

$x = 16$  so  $x + 4 = 20$

4. In paragraph form (3 or 4 sentences), explain what conclusions the class made yesterday about area and perimeter?

**We concluded that if perimeter stays constant, area can change. We also were reminded that  $A = lw$  and  $P = 2w + 2l$ . We also practiced area and perimeter problems.**

**PROBLEM #1**

I. List the assumptions that are most relevant in determining the dimensions of Penny's pen.

**Penny's pen must be rectangular.**

**Assume 40 feet of fencing.**

**Penny's pen must be away from the house.**

**Penny's pen must have the most area possible.**

II. Fill in the table below and find a pattern to determine the most suitable dimensions for Penny's pen. **Some possible lines of data are: (correct answer is length 10)**

[A]	[B]	[C]	[D]	[E]	[F]
[Input]	$2*[A]$	$40-[B]$	$[C]/2$	$[B] + [C]$	$[A] * [D]$
LENGTH	$2*LENGTH$	$2*WIDTH$	WIDTH	PERIMETER	AREA
1	2	38	19	40	19
3	6	34	17	40	51
6	12	28	14	40	84
7	14	26	13	40	91
8	16	24	12	40	96
9	18	22	11	40	99
10	20	20	10	40	100
11	22	18	9	40	99
12	24	16	8	40	96
14	28	12	6	40	84
16	32	8	4	40	64
18	36	4	2	40	36

III. Based on above findings, what is the maximum area that Penny's pen can be?

a) **100 square feet**

b) Explain. **All other lengths and widths yielded smaller areas than 100 square feet. The fencing used remained at 40 feet.**

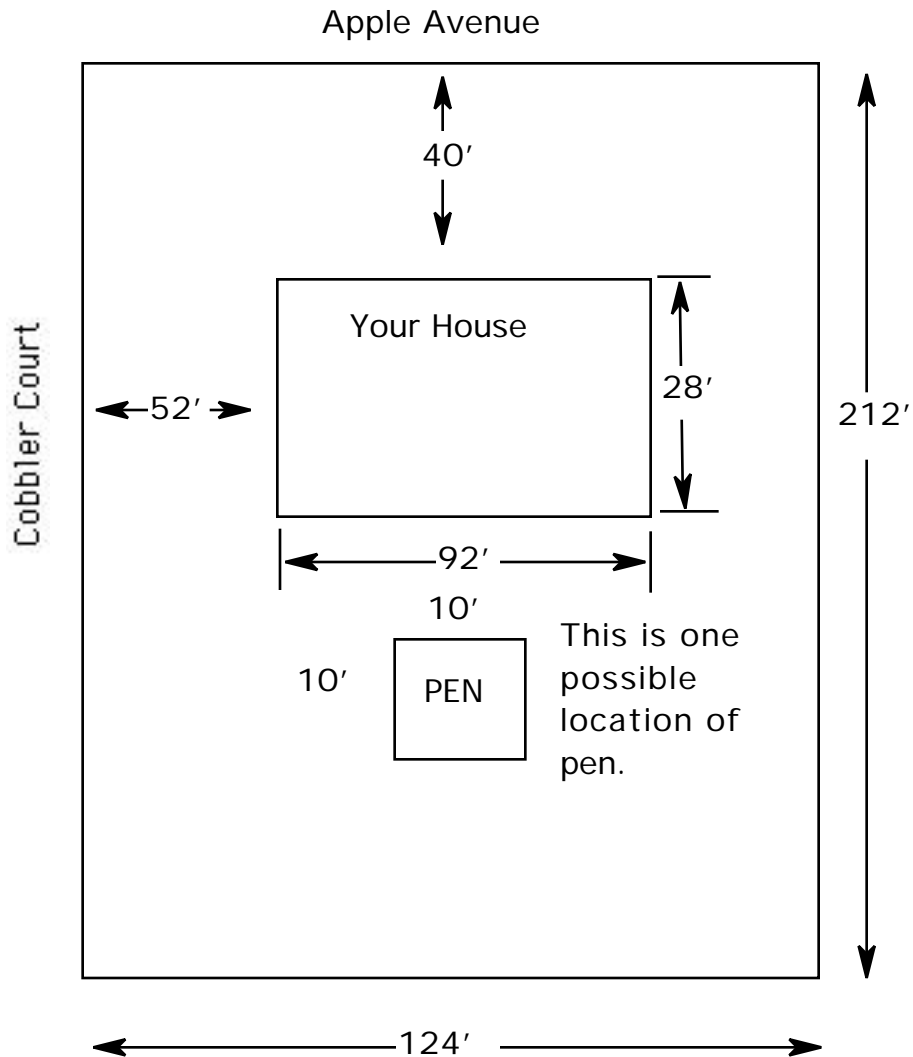
c) What geometric shape is Penny's pen? **10' x 10' This is a square.**

IV. Use your straightedge to draw Penny's pen on your property.

V. With your teacher, you will now construct the table you have created above on a graphing calculator. See Addendum 1 for detailed instructions.

## ANSWER KEY

### Your Property (for problem #1)



I. Given the dimensions of your property, your task is to build an isolated pen (away from the house) for Penny behind your house. You want to have the largest possible area for the pen to provide Penny room to roam freely. Write the data numbers in the spaces above and sketch or draw Penny's pen on your property. (Remember to label all measurements.)

**PROBLEM #2**

**I.** List the assumptions that are most relevant in determining the dimensions of Penny's pen (at least one should be different from those you listed in Problem #1).

**Penny's pen must be rectangular.**

**Assume 40 feet of fencing.**

**Penny's pen is not necessarily isolated.**

**Penny's pen must have the most area possible.**

**II.** With your partner, design a table using a graphing calculator to solve the problem. Your table should make use of formulas to calculate data. When the table is complete, copy your column headings (the headings you would use if you were writing on paper), formulas, and the line of data which contains the maximum area in the table below.

Graph. Calc. Headings ->	L1	L2	L3	L4	L5
Column Headings ->	Length	2*Length	Width	Fence Perimeter	Area
Formulas ->	Data Entry	2*L1	40 - L2	L2 + L3	L1 x L3
Maximum Area ->	10	20	20	40	200

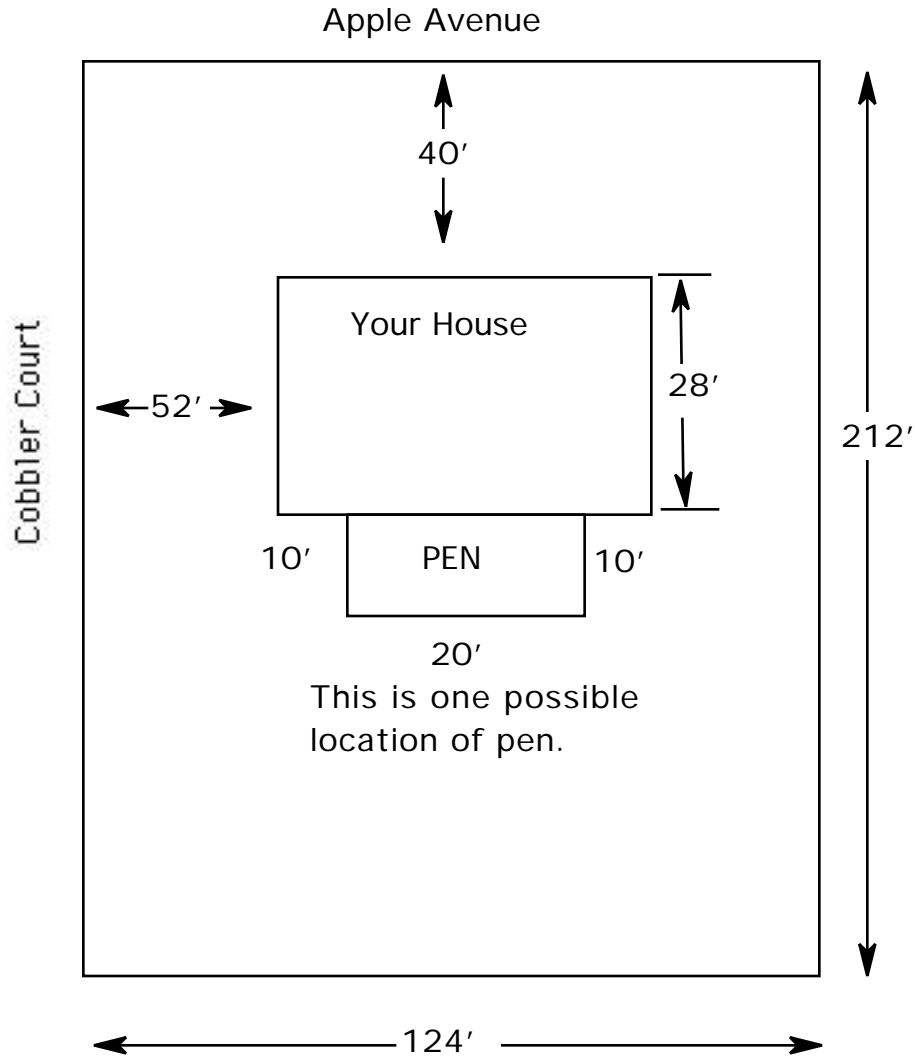
**III.** Based on the table you built, what is the new maximum area that Penny's pen can be?

- 200 square feet**
- Explain. **All other lengths and widths yielded smaller areas. The perimeter of fencing used remained at 40 feet.**
- What geometric shape is Penny's pen? **10' x 20' This is a rectangle.**

**IV.** Use your straightedge to draw Penny's pen on your property.

## ANSWER KEY

### Your Property (for problem #2)



II. Your next task is to design a pen for Penny which is not necessarily isolated (away from the house). You still want to maximize the area. (Remember to label all measurements and make a new sketch.)

**PROBLEM #3**

**I.** List the assumptions that are most relevant in determining the dimensions of Penny's pen (at least one should be different from those you listed in Problem #2).

**Penny's pen must be rectangular.**

**Assume 40 feet of fencing.**

**A garage is adjoined to the house.**

**Penny's pen is not necessarily isolated.**

**Penny's pen must have maximum area possible.**

**II.** With your partner, design a table using a graphing calculator to solve the problem. Your table should make use of formulas to calculate data. When the table is complete, copy your column headings (the headings you would use if you were writing on paper), formulas, and the line of data which contains the maximum area in the table below.

Graph. Calc. Headings ->	L1	L2	L3	L4
Column Headings ->	Length	Width	Fence Perimeter	Area
Formulas ->	Enter Data	$40 - L1$	$L1 + L2$	$L1 \times L2$
Maximum Area ->	20	20	40	400

**III.** Based on the table you built, what is the new maximum area that Penny's pen can be?

- 400 square feet**
- Explain. **All other lengths and widths yielded smaller areas while fencing remained constant at 40 feet. Also, maximum area is achieved if pen is placed in corner formed by garage and house.**
- What geometric shape is Penny's pen? **20' x 20' This is a square.**

**IV.** Use your straightedge to draw Penny's pen on your property.

**V.** a) What geometric shape were two of the three pens you designed for Penny?

**Squares**

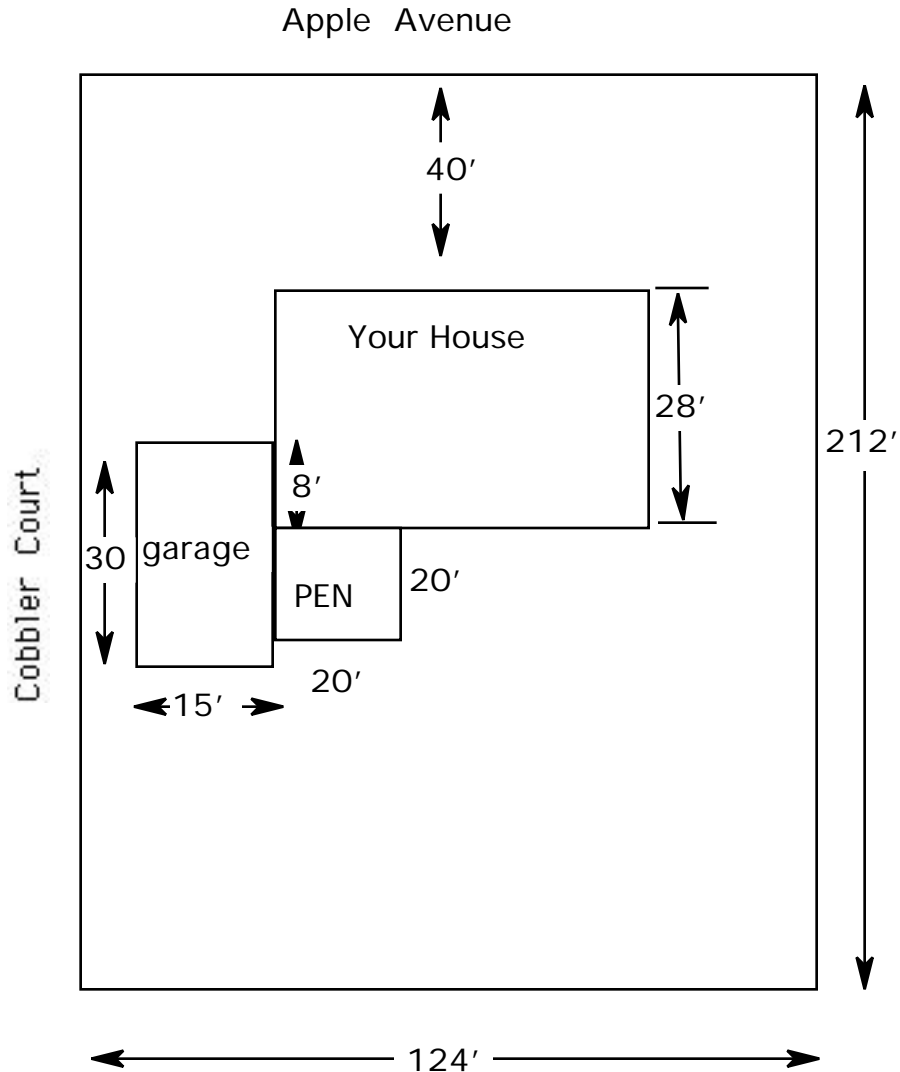
- Can you draw a conclusion about maximizing area while keeping perimeter constant? Write your conclusion in complete sentences.

**It seems that if perimeter remains constant, then area will be maximized if a square is used. The square always seems to provide the largest area.**



## ANSWER KEY

### Your Property (with garage)(for problem #3)



III. Your final task is to build a different pen for Penny. Remember you only have 40 feet of fencing to work with and you still want to have the largest possible area. (Remember to label all measurements.) (Hint: Your pen should not be isolated(away from the house).)

## ANSWER KEY

### *Addendum 1*

#### *Instructions for use of graphing calculator*

You will now use the graphing calculator to build the table you used in Problem #1. You will find that it does many of your tedious calculations for you.

**Note: Words in uppercase letters represent a button on your calculator.**

1) Press STAT, then 1. You should now see columns across your screen, labeled L1, L2, etc. Record the column headings from your table in order below:

L1: **LENGTH**

L2: **2\*LENGTH**

L3: **WIDTH**

L4: **2\*WIDTH**

L5: **FENCE PERIMETER**

L6: **AREA**

2) If there is data in your columns you need to clear it out. Arrow up to the heading (L1) and press CLEAR. Then arrow down one or two spaces. The column should now appear empty. Do this to clear all your columns.

3) Enter the data in your first column under L1 (this should represent “length”) by using the number keys and the arrow keys.

4) Now that your numbers are entered you need to write the formulas which will calculate the rest of the data in your table. Arrow up and put your cursor over the heading L2.

5) The L2 column will calculate  $2 * \text{length}$  (remember that length is in column L1). You will enter the formula  $2 * L1$  by following these keystrokes:

2 ; X ; 2ND ; 1 (this will enter L1 in your calculator) ; ENTER

Column L2 should now have numbers in it. They should be double the numbers you entered in column L1.

5) Now arrow over to column L4 (we will go back to L3 next) and move your cursor over the heading L4. This column represents  $2 * \text{width}$ . A formula you could use to calculate this column is:  $40 - (2 * \text{length})$ . Remember,  $(2 * \text{length})$  is already calculated in L2 so our formula will be:  $40 - L2$ .

It should be entered into the calculator using the following keystrokes:  
40 ; - ; 2nd ; 2 (this will enter L2); ENTER

6) Arrow back over to the L3 column heading. This column represents width. How do you think you will write the formula for this column? **L4 DIVIDED BY 2**

7) A formula you could use is:  $(2 * \text{width}) / 2$  so this will be entered by following these keystrokes: 2nd ; 4 ; Divide ; 2 ; ENTER.

8) Arrow over to the L5 heading. This column calculates the perimeter of the fencing in feet. A formula you could use is  $(2 * \text{length}) + (2 * \text{width})$ .  
remember this is:            L2            L4

To enter this formula, follow these keystrokes: 2nd ; 2 ; + ; 2nd ; 4 ; ENTER.

9) Arrow over to the L6 heading. This final column calculates area. A formula you could use is: length \* width. Which two columns were these? **L1 and L3**

10) Enter this formula by following these keystrokes: 2nd ; 1 ; x ; 2nd ; 3 ; ENTER

11) Your table is now complete and should match the table you constructed using paper and pencil in Problem #1.

## **Performance Assessment**

### **Teacher's Guide:**

#### **Introduction**

The purpose of the assessment activity is to provide feedback to tell you whether students learned the concepts that were taught. The information gathered from this assessment can be used so that appropriate instructional decisions can be made, such as whether to start a new unit or reteach. This assessment should be given at the conclusion of the learning unit on perimeter and area. There are a few questions designed to assess whether students can extend the concept of perimeter to triangles. The questions are centered around real-world applications as much as possible.

**Objectives -** Students will demonstrate their ability to:

- use the formulas for perimeter and area of a rectangle to solve problems.
- solve one and two step equations.
- translate word sentences into algebraic expressions.
- use appropriate units to describe perimeter and area.

#### **Tools/Materials Needed for Assessment**

- Pencil
- Calculator
- Straightedge

#### **Administering the Assessment**

Students should complete the assessment individually. They may write directly on the assessment sheet. Students should be able to complete this assessment in approximately 30 minutes.

## Performance Assessment

### Student Response Sheet

### Perimeter and Area Assessment Task

Name: \_\_\_\_\_

Date: \_\_\_\_\_

For problems 1-3, select the best response.

- 1) If you know the area of a rectangle and its length, to find its width you need to
  - a. add
  - b. subtract
  - c. multiply
  - d. divide
- 2) The area of a rectangle describes its
  - a. distance
  - b. surface
  - c. angles
  - d. sides
- 3) If the length of a rectangle is cut in half but its width is doubled, then the area of the rectangle would
  - a. double
  - b. halve
  - c. quadruple
  - d. remain the same
- 4) The \_\_\_\_\_ of a triangle is the sum of the lengths of its sides.
- 5) The geometric figure that maximizes area is a \_\_\_\_\_.
- 6) The cost of carpet is \$3 per square foot. How much would it cost to carpet a bedroom that is 11 ft. by 14 ft.? Show all steps, include formula used and proper units.
- 7) A rectangular picture frame has a perimeter of 6 ft. The width of the frame is 0.80 times its height. Find the height of the frame *in inches*. Show all steps, include diagram, formulas used, and proper units.

8a) A student types a book report on a 8 in. by 11 in. piece of paper. The top and bottom margins are set at 1.5 in. each and the left and right margins are set at 1 in. each. He did not indent his paragraphs and he used the entire page to type, excluding the margins. What percentage of the page did he use for typing? Show all steps, include diagram, formulas used, proper units, and answer in a complete sentence.

8b) The student's completed book report takes up one full page. He was very careful not to write in the margins of the paper. He would like his report to stand out, so he plans to write his final draft on a piece of paper with unusual dimensions and no margins. Design a piece of paper that has the exact amount of area the student will need, but whose dimensions are different from the space he wrote in previously. What is the perimeter of his new piece of paper? Show all work, include diagrams, and write your answer in a complete sentence.

## Performance Assessment

### Scoring Guide

### Perimeter and Area Assessment Task Scoring Guide

Name: \_\_\_\_\_  
Date: \_\_\_\_\_

For problems 1-3, select the best response.

- 1) If you know the area of a rectangle and its length, to find its width you need to
  - a. add
  - b. subtract
  - c. multiply
  - d. divide**
- 2) The area of a rectangle describes its
  - a. distance
  - b. surface**
  - c. angles
  - d. sides
- 3) If the length of a rectangle is cut in half but its width is doubled, then the area of the rectangle would
  - a. double
  - b. halve
  - c. quadruple
  - d. remain the same**
- 4) The **perimeter** of a triangle is the sum of the lengths of its sides.
- 5) The geometric figure that maximizes area is a **square**.
- 6) The cost of carpet is \$3 per square foot. How much would it cost to carpet a bedroom that is 11 ft. by 14 ft.? Show all steps, include formula used and proper units.  
**\$462**

3 - The student uses area formula correctly with proper units and calculates the cost of the carpet.

2 - The student uses area formula correctly without proper units and calculates the cost of the carpet.

1 - The student uses area formula incorrectly without proper units and calculates the cost of the carpet incorrectly.

0 - no response

7) A rectangular picture frame has a perimeter of 6 ft. The width of the frame is 0.80 times its height. Find the height of the frame *in inches*. Show all steps, include diagram, formulas used, and proper units .20 **in**

- 3 - The student uses perimeter formula correctly with proper units, includes diagram, and calculates height correctly with proper units.
- 2 - The student uses perimeter formula correctly with proper units, includes diagram, and calculates height correctly without proper units.
- 1 - The student uses perimeter formula incorrectly, resulting in an incorrect answer.
- 0 - no response

8a) A student types a book report on a 8 in. by 11 in. piece of paper. The top and bottom margins are set at 1.5 in. each and the left and right margins are set at 1 in. each. He did not indent his paragraphs and he used the entire page to type, excluding the margins. What percentage of the page did he use for typing? Show all steps, include diagram, formulas used, proper units, and answer in a complete sentence. **54.5 %**

- 4 - The student uses area formula correctly with proper units, includes diagram, calculates percentage correctly, and answers in a complete sentence.
- 3 - Student makes one of the following errors: uses area formula incorrectly, does not make a diagram; makes the diagram incorrectly, calculates percentage incorrectly; does not use proper units, or does not answer in a complete sentence.
- 2 - Student makes two of the following errors: uses area formula incorrectly, does not make a diagram; makes the diagram incorrectly, calculates percentage incorrectly, does not use proper units, or does not answer in a complete sentence.
- 1 - Student makes three of the following errors: uses area formula incorrectly, does not make a diagram, makes the diagram incorrectly, calculates percentage incorrectly, does not use proper units, or does not answer in a complete sentence.
- 0 - No response



8b) The student's completed book report takes up one full page. He was very careful not to write in the margins of the paper. He would like his report to stand out, so he plans to write his final draft on a piece of paper with unusual dimensions and no margins. Design a piece of paper that has the exact amount of area the student will need, but whose dimensions are different from the space he wrote in previously. What is the perimeter of his new piece of paper? Show all work, include diagrams, and write your answer in a complete sentence. (perimeter will vary)

- 4 - The student makes a diagram, chosen perimeter corresponds to correct area of  $48 \text{ in}^2$ , shows calculations, and writes answer in a complete sentence.
- 3 - Student makes one of the following errors: does not make a diagram, chosen perimeter does not correspond to correct area of  $48 \text{ in}^2$ , does not show calculations, or does not write answer in a complete sentence.
- 2 - Student makes two of the following errors: does not make a diagram, chosen perimeter does not correspond to correct area of  $48 \text{ in}^2$ , does not show calculations, or does not write answer in a complete sentence.
- 1 - Student makes three of the following errors: does not make a diagram, chosen perimeter does not correspond to correct area of  $48 \text{ in}^2$ , does not show calculations, or does not write answer in a complete sentence.
- 0 - No response